



PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Kazuya OTA, Akikazu TANIMOTO, Tsuneyuki HAGIWARA,
Hideki KOMATSUDA and Takashi MORI

Application No.: 09/846,304

Group Art Unit: 2851

Filed: May 2, 2001

Docket No.: 1043.01

For: APPARATUS AND METHOD FOR PATTERN EXPOSURE
AND METHOD FOR ADJUSTING THE APPARATUS

SECOND PRELIMINARY AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D. C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE CLAIMS:

Please cancel claims 2-11, 13-16 and 27 without prejudice to or disclaimer of the
subject matter contained therein.

Please replace claims 1, 12, 17-21, 23-25 and 28 as follows:

1. (Amended) A method for performing an optical adjustment on an exposure
apparatus which exposes an object with exposure light from a light source, comprising:

generating, from said light source, non-exposure light having a wavelength
which is different from that of said exposure light, said non-exposure light including at least
one of ultraviolet light and visible light;

adjusting an optical property of an optical system through which said exposure
light passes by receiving said non-exposure light from said light source through at least a part

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of the optical system, said optical system including at least an illumination system which irradiates said exposure light onto an original; and

generating said exposure light from said light source to obtain an optical property of said optical system at the wavelength of said exposure light.

12. (Amended) An exposure apparatus which exposes an object with exposure light, comprising:

a light source in which optical components are installed and which generates said exposure light and non-exposure light having a wavelength which is different from that of said exposure light and including at least one of ultraviolet light and visible light;

an optical system disposed on an optical path through which said exposure light passes and including at least an illumination system which irradiates said exposure light onto an original; and

a photo-sensor that receives said non-exposure light from said light source through at least a part of said optical system and output of which is used in adjustment of an optical property of said optical system;

wherein said optical property is adjusted based on the output from said photo-sensor, and said exposure light is generated from said light source to obtain an optical property of said optical system at the wavelength of said exposure light.

17. (Twice Amended) An apparatus according to claim 12, further comprising:

a wavelength selection device disposed between said light source and said optical system to select one of said exposure light and said non-exposure light, emitted from said light source, toward said optical system.

18. (Amended) An exposure apparatus which exposes an object with exposure light, comprising:

an x-ray source that generates x-rays used as said exposure light; and

a light source observation system that forms an image of said x-ray source with light, having a wavelength which is different from that of said exposure light, generated concurrently with said x-rays from said x-ray source to obtain positional information with respect to said x-ray source, said light including one of ultraviolet light and visible light.

19. (Amended) An apparatus according to claim 18, wherein said x-ray source is a laser excitation plasma source that generates said x-rays from a substance by irradiation of a laser beam.

20. (Amended) An apparatus according to claim 18, wherein said light source observation system includes first and second optical systems, which are positioned so as to observe said x-ray source from different directions.

21. (Amended) An apparatus according to claim 18, wherein said light source observation system includes first and second optical systems of which optical axes intersect each other.

23. (Amended) A method of adjusting an exposure apparatus having an x-ray source, which exposes an object with exposure light from the x-ray source, comprising:

generating, from said x-ray source, light having a wavelength which is different from that of said exposure light, said light including one of ultraviolet light and visible light;

adjusting said x-ray source with respect to an illumination system which irradiates said exposure light onto an original, by receiving said light.

24. (Amended) A method of exposing an object with exposure light from an x-ray source, comprising:

adjusting said x-ray source with respect to an illumination system which irradiates said exposure light onto an original, by receiving light, having a wavelength which

is different from that of said exposure light, generated from said x-ray source, said light including one of ultraviolet light and visible light; and

illuminating said original with said exposure light through said illumination system to expose said object with the illuminated original.

25. (Amended) A method of making an exposure apparatus which exposes an object with exposure light, comprising:

arranging an optical system in an optical path through which said exposure light passes, said optical system including an at least illumination system which irradiates said exposure light onto an original;

providing a light source that generates said exposure light and non-exposure light having a wavelength which is different from that of said exposure light and including at least one of ultraviolet light and visible light;

adjusting an optical property of said optical system by receiving said non-exposure light from said light source through at least a part of said optical system; and

adjusting the optical property of said optical system at the wavelength of said exposure light by receiving said exposure light from said light source through at least a part of said optical system.

28. (Amended) A method according to claim 26, wherein said exposure light has a wavelength in a range of 5 to 50 nanometers.

Please add new claims 29-50 as follows:

--29. A method according to claim 1, wherein said exposure light comprises extreme ultraviolet light having a wavelength in a range of 5 to 50 nanometers, and said non-exposure light has a wavelength longer than that of said exposure light.--

--30. A method according to claim 29, wherein said optical property of said optical system is adjusted while an optical path therefor is kept in an atmosphere being substantially the same as atmospheric air.--

--31. A method according to claim 30, wherein said optical system includes at least one of an illumination system which irradiates said exposure light on a pattern and a projection system which projects an image of the pattern on said object.--

--32. A method according to claim 1, further comprising:

adjusting the optical property of said optical system based on said obtained optical property at the wavelength of said exposure light.--

--33. A method according to claim 32, wherein said adjustment of said optical property by receiving said non-exposure light is performed under an atmosphere being different from an atmosphere under which said adjustment of said optical property by receiving said exposure light is performed.--

--34. A method according to claim 33, wherein said adjustment of said optical property by receiving said exposure light is performed while an optical path therefor is kept in a substantial vacuum.--

--35. A method according to claim 33, wherein said exposure light comprises extreme ultraviolet light having a wavelength in a range of 5 to 50 nanometers.--

--36. A method according to claim 1, wherein said optical property of said optical system is adjusted under an atmosphere being different from an atmosphere under which said object is exposed.--

--37. A method according to claim 36, wherein said object is exposed under an atmosphere being different from atmospheric air.--

--38. A method according to claim 36, wherein said optical property of said optical system is adjusted while an optical path therefor is kept in an atmosphere being different from a vacuum.--

--39. A method according to claim 36, wherein said exposure light comprises extreme ultraviolet light having a wavelength in a range of 5 to 50 nanometers.--

--40. An apparatus according to claim 12, wherein said optical system includes a projection system which projects an image of said original on said object.--

--41. An apparatus according to claim 40, wherein said exposure light comprises extreme ultraviolet light having a wavelength in a range of 5 to 50 nanometers, and said non-exposure light has a wavelength longer than that of said exposure light.--

--42. An apparatus according to claim 41, wherein said photo-sensor receives said non-exposure light while an optical path therefor is kept in an atmosphere being substantially the same as atmospheric air.--

--43. An apparatus according to claim 12, wherein said photo-sensor receives said non-exposure light under an atmosphere being different from atmosphere under which said object is exposed.--

--44. An apparatus according to claim 43, wherein said object is exposed while an optical path therefor is kept in an atmosphere being different from atmospheric air.--

--45. An apparatus according to claim 43, wherein said photo-sensor receives said non-exposure light while an optical path therefor is kept in an atmosphere being different from a vacuum.--

--46. An apparatus according to claim 43, wherein said exposure light comprises extreme ultraviolet light having a wavelength in a range of 5 to 50 nanometers.--

--47. A method according to claim 23, wherein said x-ray source is adjusted based on an image of said x-ray source formed with said generated light.--

--48. A method according to claim 23, wherein said x-ray source is a laser excitation plasma source that generates extreme ultraviolet light as said exposure light.--

--49. A method according to claim 24, wherein said x-ray source is a laser excitation plasma source that generates extreme ultraviolet light as said exposure light and is adjusted based on an image of said x-ray source formed with said generated light.--

--50. A method according to claim 25, wherein said adjustment of said optical property by receiving said non-exposure light is performed under an atmosphere being different from an atmosphere under which said adjustment of said optical property by receiving said exposure light is performed.--

REMARKS

Claims 1, 12, 17-26 and 28-50 are pending. By this Amendment, claims 2-11, 13-16 and 27 are canceled, claims 1, 12, 17-21, 23-25 and 28 are amended, and claims 29-50 are added.

The attached Appendix includes marked-up copies of each rewritten claim (37 C.F.R. 1.121(c)(ii)).

I. The Claims Define Patentable Subject Matter

The Office Action of the parent application rejects parent application claims 1-16 and 24-28 under 35 U.S.C. §103 as unpatentable over U.S. Patent No. 5,981,001 to Komatsu et al. (hereinafter "Komatsu et al.") in view of U.S. Patent No. 5,953,106 to Unno et al. (hereinafter "Unno et al.") and U.S. Patent No. 5,506,684 to Ota et al. (hereinafter "Ota et al."); and parent application claims 18-23 under 35 U.S.C. §103 as unpatentable over Komatsu et al. in view of Unno et al. and Ota et al. and further in view of U.S. Patent No. 5,262,257 to Fukuda et al. (hereinafter "Fukuda et al."). The rejections are traversed below with respect to the pending claims.

Claims 1 and 29-39

Komatsu et al. does not disclose that the optical property of an optical system through which the exposure light passes is adjusted by means of receiving non-exposure light which is generated by a light source and transmitted through at least a part of the optical system.

Unno et al. discloses a technique for compensating for thermal changes in lenses. However, Unno et al. does not disclose the use of a light source which generates both exposure light and non-exposure light, nor does it disclose that the optical property of an optical system through which the exposure light passes is adjusted by means of receiving the non-exposure light which is generated by the light source and transmitted through at least a part of the optical system.

Ota et al. discloses the use of a laser light source (20) which generates two types of lights. However, because this laser light source (20) cannot generate exposure light, Ota et al. clearly fails to disclose a light source generating both exposure light and non-exposure light. Furthermore, Ota et al. fails to disclose a method for adjusting the optical property of an optical system, through which the exposure light passes, by means of receiving the non-exposure light which is generated by the light source and transmitted through at least a part of the optical system.

Claims 12, 17 and 40-46

Komatsu et al., Unno et al., and Ota et al. do not disclose a photo-sensor which receives non-exposure light from a light source through at least a part of the optical system and the output of which is used in adjustment of an optical property of said optical system.

Claims 18-22

Komatsu et al., Unno et al., and Ota et al. do not disclose the use of an x-ray source that generates x-rays as the exposure light, nor do they disclose a light source observation system that forms an image of the x-ray source with light, having a wavelength which is

different from that of the exposure light, generated concurrently with the x-rays from the x-ray source to obtain positional information with respect to the x-ray source.

Claims 23, 47 and 48

Komatsu et al., Unno et al., and Ota et al. do not disclose the use of an x-ray source that generates x-rays as exposure light, nor do they disclose the step of adjusting the x-ray source by receiving light which is generated by the x-ray source and has a wavelength different from that of the exposure light.

Claims 24 and 49

Komatsu et al., Unno et al., and Ota et al. do not disclose the step of exposing an object with exposure light from an x-ray source, nor do they disclose the step of adjusting the x-ray source by receiving light, having a wavelength which is different from that of the exposure light, generated from the x-ray source.

Claims 25, 26, 28 and 50

Komatsu et al., Unno et al., and Ota et al. do not disclose the step of adjusting the optical property of an optical system by receiving non-exposure light from the light source through at least a part of the optical system, nor do they disclose the step of adjusting the optical property of the optical system by receiving exposure light from the light source through at least a part of the optical system. Specifically, this art fails to disclose adjusting the optical property of the optical system using both the exposure light and the non-exposure light.

Summary

For at least these reasons, it is respectfully submitted that claims, 1, 12, 17-26 and 28-50 are distinguishable over the applied art.

II. Conclusion

In view of the foregoing remarks, Applicants respectfully submit that this application is in condition for allowance. Favorable consideration and prompt allowance are earnestly solicited.

Should the Examiner believe anything further is desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned representative at the telephone number listed below.

Respectfully submitted,



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JAO:EDM/gam

Attachments:
Appendix
Amendment Transmittal

Date: December 18, 2001

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APPENDIX

Changes to Claims:

Claims 2-11, 13-16 and 27 are canceled.

Claims 29-50 are added.

The following are marked-up versions of the amended claims:

1. (Amended) A method for performing an optical adjustments on an exposure apparatus which exposes an object with exposure light from a light source, comprising:
_____ generating, from said light source, non-exposure light having a wavelength which is different from that of said exposure light, said non-exposure light including at least one of ultraviolet light and visible light;
_____ adjusting an optical property of an optical system through which said exposure light passes by receiving said non-exposure light from said light source through at least a part of the optical system, said optical system including at least an illumination system which irradiates said exposure light onto an original; and
_____ generating said exposure light from said light source to obtain an optical property of said optical system at the wavelength of said exposure light~~provided with: a light source for generating illumination light for exposure, and illumination optics for irradiating a mask with said illumination light and exposing a mask pattern on a substrate base using said illumination light, comprising:~~
_____ activating a wide bandwidth light source serving as said light source for generating exposure light and non-exposure light having wavelengths different from wavelengths in said exposure light; and
_____ performing optical adjustments on optical components in at least a part of said illumination optics using said non-exposure light.

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12. (Amended) An exposure apparatus which exposes an object with exposure light, comprising:

a light source in which optical components are installed and which generates said exposure light and non-exposure light having a wavelength which is different from that of said exposure light and including at least one of ultraviolet light and visible light;

an optical system disposed on an optical path through which said exposure light passes and including at least an illumination system which irradiates said exposure light onto an original; and

a photo-sensor that receives said non-exposure light from said light source through at least a part of said optical system and output of which is used in adjustment of an optical property of said optical system;

wherein said optical property is adjusted based on the output from said photo-sensor, and said exposure light is generated from said light source to obtain an optical property of said optical system at the wavelength of said exposure light~~for exposing a mask pattern onto a substrate base comprised by: a light source for generating illumination light for exposure; and illumination optics for irradiating said illumination light emitted from said light source on a mask, wherein said light source is a wide bandwidth light source for generating exposure light and non-exposure light having wavelengths different from wavelengths in said exposure light; and said exposure apparatus is provided with a photo-sensor for detecting said non-exposure light that has passed through at least a part of optical components in said illumination optics.~~

17. (Twice Amended) An apparatus according to claim 12, wherein further comprising:

a wavelength selection device is provided for transmitting disposed between said light source and said optical system to select one of said exposure light and said

non-exposure light, emitted from said ~~wide bandwidth~~ light source, towards illumination-
~~optics~~ said optical system.

18. (Amended) An exposure apparatus ~~having an~~ which exposes an object with exposure light, comprising:

an x-ray source for generating that generates x-rays by generating a plasma from a substance so as to use x-rays generated from used said x-ray source as said exposure light; and

wherein a light source position-observation system is provided to that forms an image of said x-ray source using with light, which has having a wavelength which is different from that of said x-rays and is exposure light, generated concurrently with said x-rays from said x-ray source to obtain positional information with respect to said x-ray source, said light including one of ultraviolet light and visible light.

19. (Amended) An apparatus according to claim 18, wherein said x-ray source is a laser excitation plasma ~~x-ray source for producing plasma that generated~~ generates said x-rays by irradiating from a substance by irradiation of with a laser to generate a plasma of said substance beam.

20. (Amended) An apparatus according to claim 18, wherein said light source position-observation device system includes a first ~~light source position-observation system~~ and a second ~~light source position-observation~~ optical systems, which are positioned so as to observe said x-ray source from different directions.

21. (Amended) An apparatus according to claim 18, wherein said light source position-observation device system includes a first and light source position-observation system and a second ~~light source position-observation~~ optical systems, of which optical axes intersect each other of said first light source position-observation system and said second light

~~source position observation system are at least partially parallel with an optical axis of said x-rays, and are disposed so as to be at ninety degrees to an optical axis of x-rays.~~

23. (Amended) A method for positioning an x-ray source for emitting exposure light of adjusting an exposure apparatus having an x-ray source, which exposes an object with exposure light from the x-ray source, comprising:

_____ generating x-rays from an said x-ray source, that produces x-rays by generating a plasma of a substance; and positioning said x-ray source using light which has having a wavelength which is different from that of said exposure light, said light including one of ultraviolet light and visible light;

_____ adjusting said x-ray source with respect to an illumination system which irradiates said exposure light onto an original, by receiving said light x-rays and is generated concurrently with said x-rays from said x-ray source.

24. (Amended) A method for exposure of exposing an object with exposure light from an x-ray source, comprising:

_____ adjusting said x-ray source with respect to an illumination system which irradiates said exposure light onto an original, by receiving light, having generating x-rays from an x-ray source that produces x-rays by generating a plasma of a substance; positioning said x-ray source using light which has a wavelength which is different from that of said exposure light, x-rays and is generated concurrently with said x-rays from said x-ray source, said light including one of ultraviolet light and visible light; and

_____ illuminating said original with said exposure light through said illumination system to expose said object with the illuminated original then performing an exposing process.

25. (Amended) A method for manufacturing of making an exposure apparatus which exposes an object with comprises a light source for generating first illumination light

~~as exposure light and second illumination light having a wavelength different from that of said first illumination light, comprising:~~

~~arranging an optical system in an optical path through which said exposure light passes, said optical system including an at least illumination system which irradiates said exposure light onto an original of said first and second illumination light;~~

~~providing a light source that generates said exposure light and non-exposure light having a wavelength which is different from that of said exposure light and including at least one of ultraviolet light and visible light;~~

~~adjusting an optical property of said optical system by receiving said non-exposure light from said light source through at least a part of said optical system detecting said second illumination light passing through said optical path; and~~

~~adjusting the optical property of said optical system at the wavelength of said exposure light by receiving said exposure light from said light source through at least a part of said optical system by detecting said first illumination light passing through said optical path.~~

28. (Amended) A method according to claim 2726, wherein said first-illuminationexposure light has a wavelength in a range of 5~ to 50 nanometers.